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## IMPROVING COMPETITIVENESS AND TRADE BALANCE OF GREEK ECONOMY: A COOPETITIVE STRATEGY MODEL

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### Abstract:

*In this work, we propose a coopetitive model applied to the Greek crisis, aimed both at improving the competitiveness of the Greek productive system and rebalancing the current account balance of the country.*

*Our model of coopetition (based on normal form game theory) is conceived at a macro level, wherein there are two players: Greece and SNC (the Surplus Northern Countries of the euro area). We suggest a model that looks for a win-win solution. The win-win solution entails a cooperative bi-strategy in which SNC should contribute to re-balance its trade surplus with respect to Greece and, in addition, SNC should provide a certain amount of foreign direct investment (FDI) to improve the competitiveness and the growth in Greece. Thus we find a transferable utility and properly coopetitive solution, convenient for all the players.*

**Keywords:** Games and economics; coopetition, cooperation, competitiveness; trade balance; foreign direct investment; Greek economy.

**JEL Classification:** C71, C72, C78, F2, F23, F42, O24

### 1. Introduction

How can we help Greece to find solutions to overcome or, at least, improve its economy, which is still suffering from a deep crisis since 2010? Which policy actions can be taken within the euro system to make the Greek economy more competitive and steer the country towards a path of sustainable economic growth? The austerity measures imposed by the European authorities and the IMF to Greece revealed their limits, determining a long and deep recession and making the recovery very problematic, as Mussa (2010) had already foreseen. In this work we devise a coopetitive model aimed both at rebalancing the current account balance of Greece and make its productive system more competitive. So, we propose a model that looks for a win-win solution. This model, based on normal form game theory and conceived at a macro level, aims at suggesting feasible solutions in a coopetitive perspective for the divergent interests, which drive the economic policies of the countries in the euro area.

In the model we consider only two players: Greece and the Northern Countries of the euro area in surplus (SNC), namely: Germany, Austria, France, Finland, Netherlands and Luxembourg. In fact, since 2008, these latter countries have become much more competitive than the Southern countries of the euro area (Greece, Portugal, Spain and Italy), thus these Northern countries have obtained large current account surpluses. In our model the win-win solution entails that SNC should contribute to re-balance its trade surplus with respect to Greece.

In addition, SNC should provide a certain amount of foreign direct investment (FDI) that can improve the competitiveness of Greek economy, FDI may also become an important part of a new strategy of growth in Greece because of its spillover effects. This economic policy strategy based on coopetition pursued by SNC and Greece is convenient for both since it will help to make the euro area a financially stable region; in addition the improved competitiveness of Greece will favor its growth and this will benefit SNC as well. We are indeed aware that this model is built on some special assumptions, though not unrealistic, so our analytical framework of coopetition represents a partial and possible way out of the economic crisis that hits the Greek economy.

### 2. Greece, its crisis and the strategy based on coopetition

Greece is still suffering a deep and lasting economic crisis. The rates of changes of its real GDP in the last three years, 2011, 2012, 2013, have been heavily negative, respectively -7.1%, -6.4 per cent, - 4.2 per cent (Eurostat, 2013). All this demonstrates that the austerity policies imposed by the European authorities and the IMF have produced a severe and lasting downturn in the economy

(Cline, 2013). So the only desirable and correct solution for Greece is to favor its growth (De Grauwe, 2013, Schilirò, 2012, 2013). Carfi and Schilirò have already suggested a strategy based on coopeitition to find feasible solutions to overcome the Greek crisis (Carfi, Schilirò, 2011). In the present model, like in other coopeititive models we already developed (Carfi, Schilirò, 2011, 2012, 2013), we provide a coopeititive win-win solution, a situation in which each agent (the Greece, on one side, and the *SNC*, on the other) cooperate and compete at the same time, taking into account the divergent interests of the two sides, and in which both sides gain. In this paper, more specifically, we propose a new coopeititive model where the coopeititive (shared) variables are the exports of goods and services from Greece to countries of the euro area in surplus (*SNC*) and the FDI from *SNC* to Greece. Regarding the exports of Greece towards *SNC*, this strategy can alleviate the trade deficit of the Greek economy. As far as the latter variable (FDI), Greece, by receiving inward investment, will improve its competitiveness and gains in terms of an increase in productive capacity, determined by a shift in the aggregate supply. The Greek economy will also experience an increase in the aggregate demand, with a greater production and the creation of new jobs. A very important effect of FDI is that home producers in Greece will have access to the latest technology from abroad with positive externalities on the production system; moreover there will be a positive effect on the country's capital account, since FDI represents an inflow (credit) on the capital account. Finally, there will be less need to import because goods are produced in the domestic economy. All this will concur to affect positively the competitiveness of the Greek economy, favoring the stability and growth in Greece and, in turn, benefiting the whole euro area. The present model is based on the notion of coopeitition (Branderburger, Nalebuff, 1995, 1996; Bengtsson, Kock, 1999, 2000; Luo, 2007; Padula, Dagnino, 2007). It provides a game theory framework that offers a set of possible solutions in a coopeititive context allowing us to find bargaining Pareto solutions in a win-win scenario. We already devised a coopeititive model at a macroeconomic level in which we had developed a coopeititive game by excluding the mutual influence of the actions (or strategies) for the two players (Carfi, Schilirò, 2011). This choice has allowed us to greatly simplify the model; secondly it has highlighted the coopeititive aspect, although at the expense of the classical feature of game theory. Later we developed other models (Carfi, Schilirò, 2012, 2013) where we have taken into account of this mutual influence, as in the present model we are going to describe.

### **3. The coopeititive model**

In this paper, we develop and apply the new mathematical model of a coopeititive game - introduced in Game Theory for the first time by David Carfi and already adopted by Carfi and Schilirò (2011, 2012, 2012a, 2013) in different contexts. The model introduced in this paper requires technics and competences adopted and pointed out in Carfi (2009), Carfi, Musolino (2011, 2012, 2012a, 2013, 2014) and Carfi, Ricciardello (2010, 2012, 2013) and, from a algorithmic point of view, in Agreste, Carfi, Ricciardello (2012), Carfi, Ricciardello (2010, 2012, 2013). Furthermore, we desire to notice that the Brandenburgher and Nalebuff's idea of coopeititive game is mainly used, in a mostly intuitive and non-formalized way, in Strategic Management Studies. Let us begin with our basic assumptions.

*Assumption 1.* Our first hypothesis is that *SNC* must stimulate the aggregate demand to re-balance their trade surplus in favor of Greece. Moreover, we assume that - in agreement with the Greek Government - they will invest in innovative and efficient technologies in Greece.

*Assumption 2.* The second hypothesis is that Greece, a country with a huge public debt, unsustainable to deficit/GDP and low productivity is forced by external authorities to undertake austerity measures and, since the country needs to get the equilibrium of its trade balance, it agrees to increase its exports primarily towards *SNC*.

*Assumption 3.* The coopeititive model we propose hereunder must be interpreted as a normative model, in the sense that:

- *it imposes some clear and a priori conditions to be respected, by binding contracts, in order to enlarge the possible outcomes of both countries;*
- *consequently, it shows appropriate win-win strategy solutions, chosen by considering both competitive and cooperative behaviors, simultaneously;*
- *finally, it proposes appropriate fair divisions of the win-win payoff solutions.*

*Assumption 4.* The strategy spaces of the model are:

- the strategy set of *SNC*, say  $E$ , set of all possible consumptions of *SNC* (in our model), given in a conventional monetary unit.
- the strategy set of Greece  $F$ , set of all possible reductions of public expenses of Greece (in our model), given in a conventional monetary unit (different from the above *SNC* monetary unit);
- a shared strategy set  $C$ , whose elements are determined together by the two players, *SNC* and Greece, when they determine their own respective strategy sets  $E$  and  $F$ . Every strategy  $z$  in  $C$  is a pair  $(z_1, z_2)$  of monetary amounts: the first component  $z_1$  represents an amount - given in a third conventional monetary unit - of Greek exports imported into *SNC*, by respecting a binding contract; the second component  $z_2$  represents the amount of investments of *SNC* in Greece, by respecting a binding ex-ante agreement.

Therefore, in the model, we assume that *SNC* and Greece define the set of cooperative strategies.

### 3.1. Strategy spaces and payoff functions

*Assumption 5.* In this model, we consider a linear affine mutual interaction between *SNC* and Greece, adherent to the real state of the Euro-area. Specifically:

- we consider an interaction between the two players also at the level of their non-cooperative strategies;
- we assume that Greece also should import (by contract) some *SNC* production.

*Assumption 6.* We assume that:

- any real number  $x$ , belonging to the interval  $E := [0,3]$ , represents a possible consumption of *SNC* (given in an appropriate conventional monetary unit);
- any real number  $y$ , in the same interval  $F := E$ , represents aggregate austerity measures of Greece (given in another appropriate conventional monetary unit);
- any real number  $z_1$ , again in the interval  $C_1 = [0,2]$ , represents any possible amount of Greek exports which is imported by *SNC* (given in conventional monetary unit), by a binding ex ante agreement;
- any real number  $z_2$ , in the same interval  $C_2 = [0,2]$ , represents a possible investment of *SNC* (given in another appropriate conventional monetary unit).

#### 3.1.1 Payoff function of Surplus Northern Countries of the euro area

We assume that the payoff function of *SNC*,  $f_1$ , is represented by its aggregate demand:

- $f_1$  is equal to the consumption function  $C_1$  plus the investment function  $I_1$  plus government spending (that we shall assume equal 2, constant in our interaction) plus export function  $X_1$  minus the import function  $M_1$ , that is:

$$f_1 = 2 + C_1 + I_1 + X_1 - M_1.$$

We assume that:

- *SNC*'s consumption function  $C_1$  is the first projection of the strategic cooperative space  $S := E^2 \times C$ , where the space  $C$  is the Cartesian square  $[0, 2]^2$  that is the function defined by:  $C_1(x, y, z) = x$ , for every possible *SNC* consumption  $x$  in  $E$ ; this because we assumed *SNC*'s consumption to be the first strategic component of strategy profiles in  $S$ ;
- the investment function  $I_1$  is constant on the space  $S$ , and by translation we can suppose  $I_1$  equal zero;
- the export function  $X_1$  is defined by  $X_1(x, y, z) = -y/3 - z_2/2$ , for every Greek possible austerity measure  $y$  and for every *SNC* possible investment  $y$  in innovative technology in Greece; so we assume that the export function  $X_1$  is a strictly decreasing function with respect to the individual Greek strategy and the second cooperative component strategy;
- the import function  $M_1$  is the following partial projection of the strategic space, namely  $M_1(x, y, z) = z_1$ , for every cooperative strategy  $z_1 \in 2U$  (the notable space  $U$  is the unit interval  $[0,1]$ ), because we assume the import function  $M_1$  depending only upon the

cooperative strategy  $z_1$  of the cooperative game  $G$ , our third strategic component of the 4-dimensional strategy profiles in  $S$ .

*Recap.* We then assume as payoff function of  $SNC$  the aggregate demand  $f_1$ , which in our model is equal, at every triple  $(x, y, z)$  in the profile strategy set  $S$ , to the sum of the strategies  $x$ ,  $-z_1$  with the export function  $X_1$ , viewed as a *reaction function* to the Greece investments (so that  $f_1$  is the difference of the first and third projection of the strategy profile space  $S$  plus the function export function  $X_1$ ).

Concluding, the payoff function of  $SNC$  is the function  $f_1$  of the set  $S$  into the real line  $\mathbf{R}$ , defined by:  $f_1(x, y, z) = 2 + x - y/3 - z_1 - z_2/2$ , for every triple  $(x, y, z)$  in the space  $S$ ; where the reaction function  $X_1$ , defined from the space  $S$  into the real line  $\mathbf{R}$  by:  $X_1(x, y, z) = -y/3 - z_2/2$ , for every possible investment  $y$  of Greece in the interval  $3\mathbf{U}$ , is the export function of  $SNC$  mapping the level  $y$  of Greece austerity measure and the level  $z_2$  of  $SNC$  investment in Greece into the level  $X_1(x, y, z)$  of  $SNC$  export.

### 3.1.2 Payoff function of Greece

We assume that the payoff function of Greece  $f_2$  is again its aggregate demand: namely, consumption  $C_2$  plus investment  $I_2$  plus government spending (assumed to be 1) plus exports  $X_2$  minus imports  $M_2$ ; so that:

$$f_2 = 1 + C_2 + I_2 + X_2 - M_2.$$

We assume that:

- the function  $C_2$  is relevant in our analysis, since we assume the Greek consumptions depend on the choice of the strategy austerity measure  $y$ ; we assume

$$C_2(x, y, z) = 1 - y/3;$$

- the function  $I_2 : S \rightarrow \mathbf{R}$  is defined by

$$I_2(x, y, z) = z_2 + n z_1, \text{ for every } (x, y, z) \text{ in } S;$$

- the export function  $X_2$  is the linear function defined by

$$X_2(x, y, z) = z_1 + m z_2, \text{ for every } (x, y, z) \text{ in } S \text{ (see above for the justification);}$$

- the function  $M_2$  is relevant in our analysis, since we assume the import function, by cooperative contract with  $SNC$ , dependent on the choice of the triple  $(x, y, z)$  in  $S$ , specifically, we assume the import function  $M_2$  defined on the space  $S$  by  $M_2(x, y, z) = -2x/3$ , so, Greece too, must import some  $SNC$  product, with value  $-2x/3$  for each possible  $SNC$  consumption  $x$ .

So, the payoff function of Greece is the linear function  $f_2$  of the space  $S$  into the real line  $\mathbf{R}$ , defined by:

$$f_2(x, y, z) = 2 - y/3 - 2x/3 + (1 + m) z_2 + (1 + n) z_1, \text{ for every triple } (x, y, z) \text{ in the strategic Cartesian space } S.$$

We note that the function  $f_2$  depends significantly upon the strategies  $x$  in  $E$ , chosen by  $SNC$ , and that  $f_2$  is again a linear function.

*Assumption.* We shall assume, for our specific study, the factors  $m$  and  $n$  non-negative and equal respectively (only for sake of simplicity) to 1 and 1/2.

### 3.1.3 Payoff function of the game

We so have build up a cooperative gain game with payoff function  $f : S \rightarrow \mathbf{R}^2$ , given by  $f(x, y, z) = (2 + x - y/3 - z_1 - z_2/2, 2 - y/3 - 2x/3 + (1 + m) z_2 + (1 + n) z_1) =$

$$= (2, 2) + (x - y/3, -2x/3 - y/3) + z_1(-1, 1 + n) + z_2(-1/2, 1 + m),$$

for every  $(x, y, z)$  in  $S = [0, 3]^2 \times [0, 2]^2$ .

#### 4. Study of the game $G = (f, >)$

Note that, fixed a cooperative strategy  $z$  in  $(2\mathbf{U})^2$ , the section-game  $G(z) = (p(z), >)$  - with payoff function  $p(z) : E^2 \rightarrow \mathbf{R}^2$  defined on the square  $E^2$  by:

$$p(z)(x, y) := f(x, y, z),$$

for every bi-strategy  $(x, y)$  - is the translation of the game  $G(0,0)$  by the “cooperative” vector

$$v(z) = z_1(-1, 1 + n) + z_2(-1/2, 1 + m),$$

so that, we may study the initial game  $G(0,0)$  and then we can translate the whole information of the game  $G(0,0)$ , by the vectors  $v(z)$ , to obtain the corresponding information for the game  $G(z)$  (each game  $G(z)$  is isometric to the initial game  $G(0,0)$ ).

##### 4.1. Study of the initial game $G(0,0)$

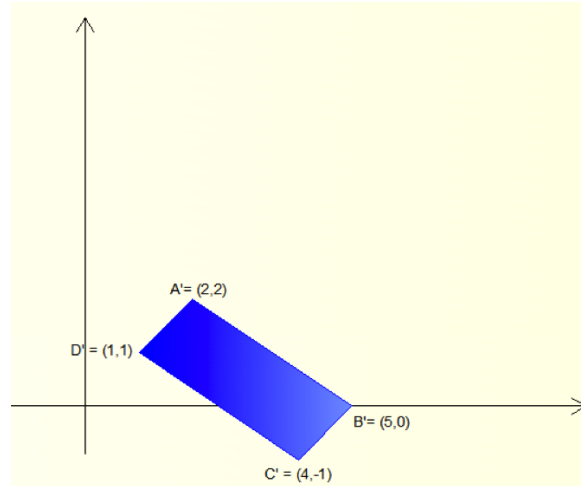
So, let us consider the initial game  $G(0,0)$ . The strategy square  $E^2$  of  $G(0,0)$  has vertices  $0_2$ ,  $3e_1$ ,  $3_2$  and  $3e_2$ , where  $0_2$  is the origin of the Cartesian plane  $\mathbf{R}^2$ ,  $e_1$  is the first canonical vector  $(1,0)$ ,  $3_2$  is the vectors  $(3, 3)$  and  $e_2$  is the second canonical vector  $(0, 1)$ .

##### 4.1.1 Topological Boundary of the payoff space of $G(0,0)$

In order to determine the payoff space of the affine game  $G(0,0)$  it suffices to transform the four vertices of the strategy square (the game is an affine invertible game), because the critical zone is empty.

##### 4.1.2 Payoff space of the game $G(0,0)$

So, the payoff space of the game  $G(0, 0) = (g, >)$ , where the function  $g$  is the section  $f((\cdot, \cdot), (0, 0))$  is the parallelogram with vertices  $g(0, 0) = (2, 2)$ ,  $g(3, 0) = (5, 0)$ ,  $g(3, 3) = (4, -1)$  and  $f(0, 3) = (1, 1)$ . As we show in Figure 1.



**Figure 1:** Initial payoff space of the game  $(f, <)$ .

#### 4.1.3 Nash equilibria

The unique Nash equilibrium of the initial game is the bi-strategy (3, 0). Indeed, the function  $g_1$  is linear and increasing with respect to the first argument; analogously, the function  $g_2$  is linear and decreasing with respect to the second argument.

#### 4.2. Study of the entire cooperative game $G = (f, >)$

##### 4.2.1 The payoff space of the cooperative game $G$

The image of the payoff function  $f$ , is the union of the family of payoff spaces  $(\text{im}(p_z))_{z \in C} = (p_z(E \times F))_{z \in C}$ , that is the convex envelope of the union of the initial payoff  $p_0(E^2)$  and of its translation by the vectors  $v(2, 0)$  and  $v(0, 2)$ . The image of the cooperative payoff function  $f$ , that is the payoff space of the game, is the convex envelope of the points  $g(0,0)$ ,  $g(3,0)$ ,  $g(3,3)$ ,  $g(0,3)$  and of their translations by  $v(2, 2)$ , as we show in Figure 2 (first step) and in Figure 3 (second step).

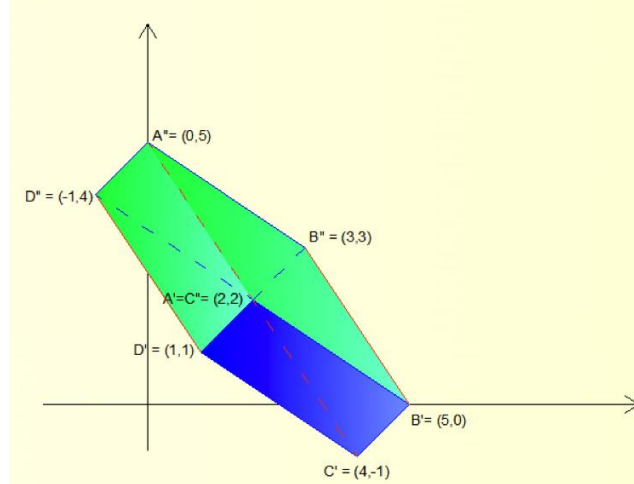


Figure 2: First dilation of the initial payoff space of the game  $(f, <)$ .

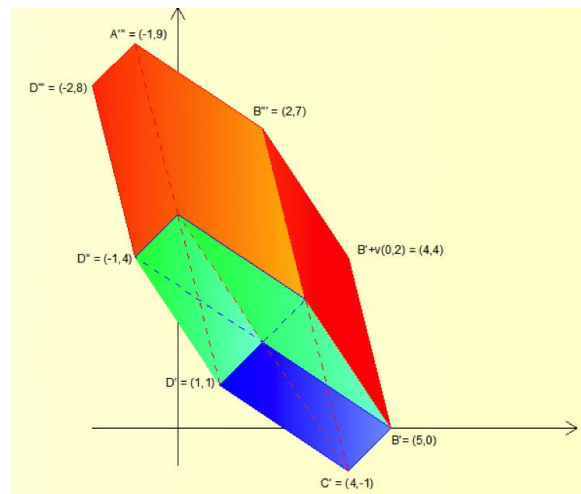


Figure 3: Payoff space of the game  $(f, <)$ , with  $m = 1$ ,  $n = 1/2$ .

#### 4.2.2 Pareto maximal boundary of the payoff space of $G$

The Pareto sup-boundary of the cooperative payoff space  $f(S)$  is the union of the segments  $[A'', B''']$ ,  $[B'', (4, 4)]$  and  $[(4, 4), B']$ , see Figure 3.

#### 4.3. Possibility of global growth

It is important to note that the absolute slopes of the segments  $[B', (4, 4)]$ ,  $[(4, 4), B''']$ , of the Pareto (cooperative) boundary, are strictly greater than 1. Thus the collective payoff  $f_1 + f_2$  of the game is not constant on the Pareto boundary and, therefore, the game implies the possibility of a transferable utility global growth.

#### 4.4. Trivial bargaining solutions

The Nash bargaining solution on the entire payoff space, with respect to the infimum of the Pareto boundary and the Kalai-Smorodinsky bargaining solution, with respect to the infimum and the supremum of the Pareto boundary, are not acceptable for *SNC*: they are collectively (i.e., from a Transferable Utility point of view) better than the Nash payoff of the initial game  $G_0$  - both solutions belong to the Pareto segment  $[(4, 4), (2, 7)]$  - but they are disadvantageous for *SNC* (they suffers a loss, with respect to  $(5, 0)$ ): these solutions could be thought as rebalancing solutions, but they are not realistically implementable.

#### 4.5. Transferable utility solutions

In this cooperative context it is more convenient to adopt a transferable utility solution, indeed: the point of maximum collective gain on the whole of the cooperative payoff space is the point  $B''' = (2, 7)$ .

##### 4.5.1 Rebalancing win-win solution relative to maximum gain for Greece in $G$

Thus we propose a rebalancing win-win cooperative solution relative to maximum gain for Greece in  $G$ , as it follows (in the case  $m = 1$ ):

- we consider the portion  $s$ , of transferable utility Pareto boundary  $M: = (2, 7) + \mathbf{R}(1, -1)$ ,
- obtained by intersecting  $M$  itself with the strip determined (spanned by convexifying) by the straight lines  $Re_1$  and  $A''' + \mathbf{R} e_1$ , these are the straight lines of Nash gain for Greece in the initial game  $G(0)$  and of maximum gain for Greece in  $G$ , respectively.
- we consider the Kalai-Smorodinsky segment  $s'$  with vertices  $(-1, 0)$  - infimum of the Pareto boundary - and the supremum of the Pareto boundary.
- our best payoff rebalancing cooperative compromise is the unique point  $K'''$  in the intersection of segments  $s$  and  $s'$ .

Figure 4 shows:

- the above Transferable Utility (TU) Kalai-Smorodinsky solution  $K'''$
- the TU Kalai-Smorodinsky solution  $K''$  with respect to the Nash zone.
- the TU Kalai-Smorodinsky solution  $K'$  with respect to the Nash extreme point  $(4, 4)$ .
- the TU Kalai-Smorodinsky solution  $K$  with respect to the initial Nash equilibrium  $(4, 4)$ .

##### 4.5.2 Win-win solution

The payoff TU Kalai-Smorodinsky solutions  $K$  represents a win-win solutions, with respect to the initial Nash gain  $B'$ . So that, as we said, also *SNC* can increase its initial gain from cooperation.



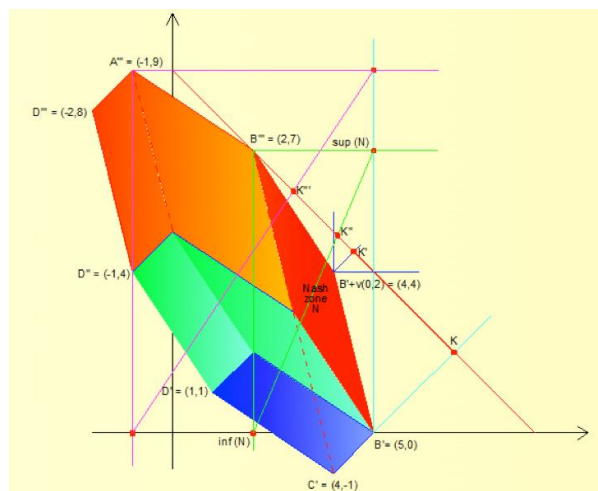


Figure 4: Kalai win-win solutions of the game  $(f, <)$ .

#### 4.5.3 Win-win strategy procedure

The win-win payoff  $K$  can be obtained in a properly transferable utility cooperative fashion, as it follows:

- the two players agree on the cooperative strategy  $(2, 2)$  of the common set  $C$ ;
- the two players implement their respective Nash strategies in the game  $G(2, 2)$ , so competing a la Nash; the unique Nash equilibrium of the game  $G(2, 2)$  is the bi-strategy  $(3, 3)$ ;
- finally, they share the “social pie”  $(f_1 + f_2)(3, 3, 2, 2)$ , in a transferable utility cooperative fashion (by binding contract) according to the decomposition  $K$ .

#### Conclusion

From our model we can draw some concluding remarks. First, the cooperative game, provided in our contribution, is essentially a normative model. Second, our example of cooperation has pointed out a win-win strategy, in a transferable utility and properly cooperative perspective, for Greece and SNC. Third, we propose a framework characterized by a cooperative bi-strategy based on two shared variables: export from Greece to SNC and FDI from SNC to Greece.

Thus, in our model we provide:

- properly cooperative solutions (not convenient for SNC): Kalai-Smorodinsky bargaining solution on the cooperative Nash path, set of all possible Nash equilibria of the cooperative interaction.
- one transferable utility and properly cooperative solution, convenient also for SNC and also rebalancing for the Euro area.
- an extended Kalai-Smorodinsky method, appropriate to determine rebalancing partitions on the transferable utility Pareto boundary of the cooperative game.

Finally, the solutions offered in our cooperative model aim at enlarging the “pie” and sharing it fairly.

In addition, they show win-win and rebalancing outcomes, for the two countries, within a cooperative game path. These solutions allow us to find “fair” amounts of Greek exports which SNC must cooperatively import, as well as the optimal amount of FDI that is necessary to improve the Greek economy, contributing to the growth and to the stability of both the Greek and SNC economies.

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